

Unit Planning Guide: Grade Algebra 2 Unit 3 of

Unit Title: Polynomial and Rational Functions	Pacing (Duration of Unit):
Grade: Algebra 2	Buffer Day(s):

Desired Results

Transfer Goals (Priority practice standards in **bold**)

Students will be able to independently use their learning to:

- MP.1. **Make sense of problems and persevere in solving them.**
- MP.2. Reason abstractly and quantitatively.
- MP.3. Construct viable arguments and critique the reasoning of others.
- MP.4. **Model with mathematics.**
- MP.5. Use appropriate tools strategically.
- MP.6. Attend to precision.
- MP.7. Look for and make use of structure.
- MP.8. Look for and express regularity in repeated reasoning.

Established Goals (2011 MA Curriculum Frameworks Standards Incorporating the Common Core State Standards)

Prerequisite Standards:

- A-SSE.3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. a. Factor a quadratic expression to reveal the zeros of the function it defines.
- N-CN.1. Know there is a complex number i such that $i^2 = -1$, and every complex number has the form $a + bi$ with a and b real.
- N-CN.2. Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. Use complex numbers in polynomial identities and equations.
- N-CN.7. Solve quadratic equations with real coefficients that have complex solutions
- A-REI.2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
- A-REI.11. Explain why the x -coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$

WIDA for English Language Learners

Standard 1: ELLs **communicate** for **Social** and **Instructional** purposes within the school setting
 Standard 3: ELLs **communicate** information, ideas and concepts necessary for academic success in the content area of **Mathematics**

In the lesson planning stage, teachers will need to differentiate lessons for ELLs. In order to accomplish this they will need: 1.) this curriculum map, 2.) a list of their ELLs and their proficiency levels, and 3.)

Unit Planning Guide: Grade Algebra 2 Unit 3 of _____

intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.«

appropriate language function expectations and scaffolds or supports.

Standards (Priority Standards in **bold**):

- **A-SSE.2.** Use the structure of an expression to identify ways to rewrite it. *For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.*
- **A-SSE.3.** Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.*
 - **A-SSE.3c.** Use the properties of exponents to transform expressions for exponential functions. *For example the expression 1.15^t can be rewritten as $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*
- **A-SSE.4.** Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments.**
- **A-APR.1:** Understand that polynomials form a system analogous to the integers, mainly, they are closed under addition, subtraction, multiplication; add, subtract, and multiply polynomials.
 - **A-APR.MA.1a:** Divide polynomials.
- **A-APR.2.** Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a , the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if $(x - a)$ is a factor of $p(x)$.
- **A-APR.3.** Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.
- **F-IF.7.** Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*
- **F-IF.7c.** Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
- **A-APR.6.** Rewrite simple rational expressions in different forms; write $\frac{a(x)}{b(x)}$ in the form $q(x) + \frac{r(x)}{b(x)}$, where

Unit Planning Guide: Grade Algebra 2 Unit 3 of _____

$a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.

- **A-APR.4.** Prove polynomial identities and use them to describe numerical relationships. *For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples.*
- **A-APR.7.** Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.
- **G-GPE.2.** Derive the equation of a parabola given a focus and directrix.

Meaning (*Mostly assessed through Performance Tasks/Assessments)

Big Ideas: (Statements and concepts written in teacher friendly language which reflect the important [but not obvious] generalizations we want students to be able to arrive at. These are used by the teacher to focus daily instruction.)

- Polynomial and rational functions can be used to model real life situations
- Polynomial functions can be described by their end-behavior, symmetry, number of zeros and number of turning points

Essential Questions: (Questions which frame ongoing and important inquiries about the big ideas. They are written for students and used in daily instruction to help engage students in meaningful thinking.)

- How can we determine if a real-world situation should be represented as a quadratic, polynomial, or exponential function?
- How can looking at multiple representations of polynomial functions (tables, equations, graphs and contextual situations) lead to greater understanding of the function?

Acquisition (*Mostly assessed through traditional summative assessments)

Unit Planning Guide: Grade Algebra 2 Unit 3 of

Knowledge: Key basic concepts, facts, and key terms (written in phrases) students should be able to recall independently.

Students will know ...

- That properties of mathematics can be used to alter the structure of an expression.
- That when polynomials are added, subtracted or multiplied that the result is another polynomial.
- The differences in the end behavior of the graphs as dictated by the leading coefficient and whether the function is even or odd
- The formula for a finite geometric series is used to solve problems such as calculating mortgage payments.
- The Remainder Theorem
- The Rational Zero Theorem
- The Fundamental Theorem of Algebra
- Understand that rational expressions is closed under addition, subtraction, multiplication, and division by a nonzero rational expression.

Key Academic Vocabulary

Skills: The discrete skills and process students should be able to use independently.

Students will be skilled at:

- simplifying polynomial expressions.
- Using factoring techniques such as common factors, grouping, the difference of two squares, the sum or difference of two cubes, or a combination of methods to factor completely.
- Rewriting exponential expressions to reveal quantities of interest that may be useful.
- deriving and applying the formula for the sum of a finite geometric series.
- dividing polynomials.
- applying the Remainder Theorem to solve polynomial equations.
- solving polynomial equations using synthetic division.
- factoring polynomials using the Remainder Theorem.
- using the factors of a given polynomial to identify it's zeros.
- using the Rational Zero Theorem to find the zeros of a polynomial.
- producing the graph of a polynomial function based on the factors of the polynomial and analysis of the end behavior.
- Transforming a simple rational function
- Adding, subtracting, and multiplying rational expressions.

Resource Suggestions:

- <http://www.nctm.org/>

Unit Planning Guide: Grade Algebra 2 Unit 3 of

- <http://www.illustrativemathematics.org/>
- <http://youtube.com/> → Khan Academy
- <http://www.doe.mass.edu/candi/commoncore/>
- <http://map.mathshell.org/materials/stds.php>